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(54) **Downshift inhibitor**

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Inhibiteur de rétrogradation

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## Description

### RELATED APPLICATIONS

This application claims priority from GB 9225890.4, titled "DOWNSHIFT INHIBITOR," filed December 11, 1992, and assigned to the same assignee, Eaton Corporation, as is this application.

### BACKGROUND OF THE INVENTION

#### Field of the Invention

The present invention relates to a control device/method for prohibiting downshifting of a vehicular manually shifted simple transmission, or the mainsection of a compound transmission, when an attempted shift into or a shift into the inhibited ratio(s) would result in unacceptable conditions such as probable excessive synchronous wear or burn-out and/or overspeeding of the vehicle engine.

More particularly, the present invention relates to a control for simple or compound manually shifted vehicular transmissions, particularly synchronized transmissions, which will prohibit or inhibit shift lever selection of a ratio or ratios which, under sensed vehicle conditions, such as vehicle speed, if engaged or attempted to be engaged, will result in unacceptable conditions such as excessive synchronizer wear, synchronizer burn-out and/or engine overspeeding.

### DESCRIPTION OF THE PRIOR ART

Prior art devices exist for warning against and/or prohibiting or inhibiting operator attempts to manually engage a transmission ratio which, if engaged, will overspeed the engine and/or have other undesirable results. Such devices typically involve warning devices which provide a visual and/or audible warning if an attempt is made to engage an unacceptable ratio or inhibit fuel to the engine to govern/reduce vehicle speed.

In a known generic device described in GB-A-2 019 509 in which blocking systems employ a common blocking device, there are means for sensing the movement of the shift lever, and means for sensing output shaft speed and depending upon output shaft speed means for actuating the blocking device to block the gear selector in neutral position.

The prior art devices were not totally satisfactory, as the vehicle operator may not react properly or rapidly enough to the alarm and/or the decrease in fueling may not result in a sufficiently rapid manner to prevent the undesirable consequences of engaging or attempting to engage an unacceptable transmission ratio.

In a heavy duty manually shifted synchronized transmission utilizing effective, powerful synchronizers, the synchronizers themselves, by virtue of being well designed and capable of bringing jaw clutch members

and related components quickly to synchronous speed, are open to driver abuse, which often leads to damage or premature wear/failure of the synchronizers and/or damage to the vehicle power train, such as the engine.

### SUMMARY OF THE INVENTION

In accordance with the present invention which is defined in claim 1, the drawbacks of the prior art are overcome or minimized by a control for a manually controlled vehicular transmission which is responsive to vehicle operating conditions, such as vehicle speed, to mechanically block the transmission shifting mechanism from assuming a position for selection of a ratio predetermined as unacceptable at currently sensed vehicle conditions.

By way of example, in a typical simple 6-speed manual transmission, the shift lever is shifted in the "Y-Y" direction to select one of the reverse shift rail/fork, the first/second shift rail/fork, the third/fourth shift rail/fork or the fifth/sixth shift rail/fork, and in the "X-X" direction to cause engagement or disengagement of a particular ratio, *see* U.S. Patents No. 4,550,627; 4,567,785 and 4,640,145. To prevent shifting or attempting to shift into a ratio predetermined as inappropriate for the currently sensed vehicle speed, vehicle speed (usually output shaft speed, OS) will be sensed and compared to a first reference value and to a second reference value smaller than the first reference value. If the vehicle speed is greater than the first reference value ( $OS > REF_1 > REF_2$ ), blocking means will mechanically prevent or inhibit selection of either the first/second shift rail/fork or the third/fourth shift rail/fork, and if vehicle speed is greater than the second reference value but less than the first reference value ( $REF_1 > OS > REF_2$ ), the blocking means will mechanically prevent or inhibit selection of the first/second shift rail/fork but not of the third/fourth shift rail/fork. Similar controls are applicable for the mainsections of manually shifted compound transmissions.

In a preferred structural embodiment of the present invention, a member such as a cross-shaft or a shift shaft having a unique axial or rotational position for each selection position is provided with slots or shoulders which will interact with interlock plunger means (preferably a single 3-position plunger) to permit or inhibit downshift selection movement of the member. Preferably, the plunger will be a multiple-position, solenoid-controlled device being rapidly responsive to actuation, *i.e.*, of low inertia.

Accordingly, it is an object of the present invention to provide a control for a manually operated transmission which will automatically mechanically inhibit attempted downshifts into ratios predetermined to be inappropriate under current vehicle operating conditions.

This and other objects and advantages of the present invention will become apparent from a reading of the detailed description of the preferred embodiment

taken in connection with the attached drawings.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

**FIGURE 1** is a schematic illustration of a synchronized 6-forward-speed vehicular transmission.

**FIGURE 1A** is a schematic illustration of an H-type shift patten for the transmission of **FIGURE 1**.

**FIGURE 2** is a schematic illustration of a compound transmission having a range-type auxiliary section and utilizing the automatic range shift control system of the present invention.

**FIGURE 2A** is a schematic illustration of the prior art shifting mechanisms of the transmission of **FIGURE 2**.

**FIGURE 2B** is a schematic illustration of a repeat H-type shift pattern for the transmission of **FIGURE 2**.

**FIGURE 3** is a schematic illustration of the control mechanism of the present invention as utilized with a cross-shaft-type shifting mechanism wherein the cross-shaft has a unique axial position for each shift rail selection.

**FIGURES 4-4C** are schematic illustrations of the control mechanism of the present invention as utilized with a single-shift-shaft-type shifting mechanism wherein the shift shaft has a unique rotational position for each shift fork selection.

**FIGURES 5A-5C** illustrate an assembly similar to that illustrated in **FIGURE 3** in the three positions of the blocking means of the present invention.

**FIGURES 6A-6B** are similar to **FIGURES 5A-5C**, illustrating the present invention as applied to a (4+1)x (2) 9-speed range-type compound transmission.

### **DESCRIPTION OF THE PREFERRED EMBODIMENT**

Certain terminology will be used in the following description for convenience in reference only and will not be limiting. The words "upwardly", "downwardly", "rightwardly", and "leftwardly" will designate directions in the drawings to which reference is made. The words "forward" and "rearward", will refer, respectively, to the front and rear ends of the transmission as conventionally mounted in a vehicle, being respectfully from left and right sides of the transmission as illustrated in **FIGURE 1**. The words "inwardly" and "outwardly" will refer to directions toward and away from, respectively, the geometric center of the device and designated parts thereof. Said terminology will include the words above specifically mentioned, derivatives thereof and words of similar import.

The term "compound transmission" is used to designate a change speed or change gear transmission having a multiple forward speed main transmission section and a multiple speed auxiliary transmission section connected in series whereby the selected gear reduction in the main transmission section may be compounded by further selected gear reduction in the auxiliary

transmission section. "Synchronized clutch assembly" and words of similar import shall designate a clutch assembly utilized to nonrotatably couple a selected gear to a shaft by means of a positive clutch in which attempted engagement of said clutch is prevented until the members of the clutch are at substantially synchronous rotation and a relatively large capacity friction means are utilized with the clutch members and are sufficient, upon initiation of a clutch engagement, to cause the clutch members and all members rotating therewith to rotate and substantially synchronous speed.

A manually controlled, 6-forward-speed, synchronized vehicular transmission 10 is illustrated in **FIGURE 1**. Synchronized transmissions and the synchronized jaw clutches utilized therewith are well known in the prior art, as may be seen by reference to U.S. Patents No. 4,373,403; 4,428,469; 4,989,706 and 5,111,922.

Transmission 10 is housed within a housing or case H and includes an input shaft 16 driven by a prime mover such as diesel engine E through a normally engaged, selectively disengaged master clutch C having an input section 18 connected to engine crank shaft 20 and an output section 22 for connection to the transmission input shaft 16.

Input shaft 16 carries an input gear 24 for simultaneously driving a plurality of substantially identical countershaft assemblies 26 and 26A at substantially identical rotational speeds. The two substantially identical countershaft assemblies are provided on diametrically opposite sides of mainshaft 28 which is generally coaxially aligned with the input shaft 16. Each of the countershaft assemblies comprises a countershaft 30 supported by bearings 32 and 34 in housing H, only a portion of which is schematically illustrated. Each of the countershafts is provided with an identical grouping of countershaft gears 38, 40, 42, 44, 46, 48 and 49, fixed for rotation therewith. A plurality of mainshaft gears 50, 52, 54, 56, 58 and 59 surround the mainshaft 28 and are selectively clutchable, one at a time, to the mainshaft 28 for rotation therewith by double-acting synchronized jaw clutch assemblies 60, 62 and 64 and jaw clutch 65, as is well known in the prior art. Synchronized jaw clutch 60 may also be utilized to clutch input gear 24 to mainshaft 28 to provide a direct drive relationship between input shaft 16 and mainshaft 28. Mainshaft 28 defines the output shaft of transmission 10 and is in driving relation with the vehicle drive wheels by transfer cases and/or drive axles, as is well known in the prior art.

Although transmission 10 is illustrated as a twin countershaft construction, the present invention is equally applicable to transmissions of the single-lay-shaft type.

Typically, synchronized jaw clutches 60, 62 and 64 and jaw clutch collar 65 are axially positioned by means of shift forks 60A, 62A, 64A and 65A, respectively, as symbolically illustrated in **FIGURE 3** and associated with the manually controlled shift bar housing assembly 70, as is well known in the prior art.

Mainshaft gear 59 is the reverse gear and is in continuous meshing engagement with countershaft gears 49 by means of conventional intermediate idler gears (not shown).

Synchronized jaw clutches 60, 62, and 64 are 3-position clutches in that they may be positioned in the centered, nonengaged position as illustrated, or in a fully rightwardly engaged or fully leftwardly engaged position by means of a shift lever. As is well known, only one of the clutches 60, 62, 64 and 65 is engageable at a given time and interlock means (not shown) are provided to lock the other clutches in the neutral condition.

Transmission 10 is provided with a rotational speed sensor 100 for sensing the rotational speed of mainshaft/output shaft 90 and for providing an output signal 100A indicative thereof. As is well known, output shaft speed (OS) is an indication of vehicle ground speed. As is also well known, for a given engaged ratio and a fully engaged master clutch,  $OS \cdot GR = IS = ES$  where GR is gear ratio, IS is input shaft speed, and ES is engine speed. Thus, for a given vehicle speed (OS) and gear ratio (GR), the expected engine speed at master clutch full (not slipping) engagement may be determined. As is also well known, engaging lower speed ratios (high numerical gear reductions between input shaft and output shaft) at relatively high vehicle speeds may be damaging to the engine, master clutch and/or synchronized jaw clutch associated with the engaging ratio.

**FIGURE 3** schematically illustrates a portion of a shift bar housing assembly 70 for transmission 10. Briefly, axially movable shift rails or bars 60B, 62B, 64B and 65B, respectively, carry shift forks 60A, 62A, 64A and 65A, respectively, for controlling the clutches 760, 26, 64 and 65, respectively. Shift bar housings of this type are well known in the prior art, as may be seen by reference to U.S. Patents No. 4,567,785; 4,584,895 and 4,873,881. Shift rail 60B is the fifth/sixth shift rail; shift rail 62B is the third/fourth shift rail; shift rail 64B is the first/second shift rail, and shift rail 65B is the reverse shift rail.

A cross-shaft 200 carrying a shift finger 202 is axially movable in the "Y-Y" direction for selection of a rail and rotatable to move the selected rail in the "X-X" direction for engaging and disengaging selected gear ratios. A clevis or crank connection 204 is provided for selectively, axially and rotationally moving the cross-shaft 200. Cross-shaft structures of this type may be seen in greater detail by reference to U.S. Patents No. 4,502,346 and 4,275,612. Cross-shafts also may be positioned by pneumatic, hydraulic and/or solenoid actuators or associated with direct-shift mechanisms, as is illustrated in U.S. Patent No. 4,550,627.

Referring to **FIGURES 3 AND 5A-5C**, the right-hand end 206 of cross-shaft 200 is provided with a reduced diameter extension 208 so that the cross-shaft has two different outer diameters defining a rightwardly facing intermediate surface or shoulder 210 and a rightwardly facing end face 212. As downshifts from fifth/

sixth to third/fourth or first/second and downshifts from fifth/sixth or third/fourth to first/second, all require rightward axial movement of cross-shaft 200 relative to a shift bar housing (SH), the three forward-motion selection positions of cross-shaft 200 in housing SH for forward operation are shown in **FIGURES 5A, 5B AND 5C**. In **FIGURE 5A**, shift finger 202 will engage the first/second rail; in **FIGURE 5B**, shift finger 202 will engage the third/fourth rail, and in **FIGURE 5C**, shift finger 202 will engage the fifth/sixth rail.

A blocking mechanism 214, such as a solenoid-controlled, 3-position plunger mechanism, is provided to selectively limit rightward movement of the cross-shaft 200. Blocking mechanism 214 has a plunger 216 having a fully retracted position 216A (see **FIGURE 5A**), an intermediate extended position 216B (see **FIGURE 5B**) and a fully extended position 216C (see **FIGURE 5C**). Preferably, plunger 216 is biased to the fully retracted position 216A so that it will tend to failsafe to a non-blocking position. Three-position actuator devices are well known in the prior art, as may be seen by reference to U.S. Patents No. 4,873,881; 4,899,607 and 4,936,156.

As seen in **FIGURES 5A-5C**, in the retracted position 216A of plunger 216, axial movement of cross-shaft 200 is not hindered. In intermediate extended position 216B, the plunger 216 will engage shoulder 212 to prevent rightward axial movement of cross-shaft 200 to select the first/second rail. In fully extended position 216C, the plunger 216 will engage end face 212 of cross-shaft 200 to prevent selection of both the third/fourth and the first/second shift rails.

Assuming a first reference value (above which fourth or lower gears should not be engaged) of 56 KPH (34 MPH) and a second reference value (above which second or first should gear should not be engaged) of 21 KPH (13 MPH), upon sensing a vehicle speed of less than 21 KPH, controller 218 will cause blocking means to assume the fully retracted plunger position of **FIGURE 5A**. Upon sensing a vehicle speed greater than 21 KPH but less than 56 KPH, controller 218 will cause blocking means 214 to assume the intermediate plunger extension of **FIGURE 5B**, and selection of downshifts into first or second speeds will be prevented. Upon sensing a vehicle speed of at least 56 KPH, controller 218 will cause mechanical blocking means 214 to assume the fully extended plunger position and selection of downshifts to fourth, third, second or first speeds will be prevented.

An alternate embodiment of shifting mechanism and downshift inhibiting device is illustrated in **FIGURES 4-4C**. In **FIGURE 4**, a single shift shaft 300 is illustrated that has a unique rotational position for selection of each shift fork. As shown, the third/fourth shift fork is selected, counterclockwise rotation will select the fifth/sixth shift fork, and clockwise rotation will select the first/second and then the reverse shift forks. Shift devices of this type are known in the prior art, as may be seen by reference

to U.S. Patent No. 4,920,815.

Shift shaft 300 is provided with a variable depth groove 302 defining clockwise-facing surfaces or shoulders 304 and 306, which correspond in function to shoulders 210 and 212 discussed above. In the fully extended position 216C (**FIGURE 4C**), plunger 216 will engage shoulder 306 to prevent clockwise movement of shaft 300 to select to the fourth, third, second or first speed ratios. In the intermediate extended position 216B (**FIGURE 4B**), plunger 216 will not engage shoulder 306 but will engage shoulder 304 to prevent clockwise rotation of shaft 300 sufficient to select the first or second speed ratios. Functionally, the assembly of **FIGURES 4-4C** is identical to the downshift inhibiting assembly of **FIGURES 3 AND 5A-5C** described above.

The present invention may also be utilized with a 2-position blocking mechanism wherein only one condition is sensed (*i.e.*, OS > REF) and the cross-shaft or shift shaft has only a single face or shoulder for engagement by the plunger. Such a device will also be useful to prevent undesirable downshifts in the 4-speed main-section of a compound transmission, see **FIGURES 2-2B**. A downshift inhibiting assembly utilizing a 2-position blocking mechanism is illustrated in **FIGURES 6A AND 6B**.

Referring to **FIGURES 2, 2A AND 2B**, in main transmission section 112, the input shaft 116 carries an input gear 124 for simultaneously driving a plurality of substantially identical countershaft assemblies 126 and 126A at substantially identical rotational speeds. The two substantially identical countershaft assemblies are provided on diametrically opposite sides of mainshaft 128 which is generally coaxially aligned with the input shaft 116. Each of the countershaft assemblies comprises a countershaft 130 supported by bearings 132 and 134 in housing H, only a portion of which is schematically illustrated. Each of the countershafts is provided with an identical grouping of countershaft gears 138, 140, 142, 144, 146 and 148, fixed for rotation therewith. A plurality of mainshaft gears 150, 152, 154, 156 and 158 surround the mainshaft 128 and are selectively clutchable, one at a time, to the mainshaft 128 for rotation therewith by sliding synchronized clutch collars 160, 162 and 164 as is well known in the prior art. Clutch collar 160 may also be utilized to clutch input gear 124 to mainshaft 128 to provide a direct drive relationship between input shaft 116 and mainshaft 128.

Typically, synchronized jaw clutch collars 160, 162 and 164 are axially positioned by means of shift forks 160A, 162A and 164A, respectively, associated with the manually controlled shift bar housing assembly 170, as well known in the prior art. Clutch collars 160, 162 and 164 may be of the well-known synchronized double-acting jaw clutch type.

Mainshaft gear 158 is the reverse gear and is in continuous meshing engagement with countershaft gears 148 by means of conventional intermediate idler gears (not shown). It should also be noted that while main

transmission section 112 does provide five selectable forward speed ratios, the lowest forward speed ratio, namely that provided by drivingly connecting mainshaft drive gear 156 to mainshaft 128, is often of such a high gear reduction it has to be considered a low or "creeper" gear which is utilized only for starting of a vehicle under severe conditions and is not usually utilized in the high transmission range. Accordingly, while main transmission section 112 does provide five forward speeds, it is usually referred to as a "four plus one" main section as only four of the forward speeds are compounded by the auxiliary range transmission section 114 utilized therewith.

Synchronized jaw clutches 160, 162 and 164 are 3-position clutches in that they may be positioned in the centered, nonengaged position as illustrated, or in a fully rightwardly engaged or fully leftwardly engaged position by means of a shift lever 172. As is well known, only one of the clutches 160, 162 and 164 is engageable at a given time and main section interlock means (not shown) are provided to lock the other clutches in the neutral condition.

Auxiliary transmission range section 114 includes two substantially identical auxiliary countershaft assemblies 174 and 174A, each comprising an auxiliary countershaft 176 supported by bearings 178 and 180 in housing H and carrying two auxiliary section countershaft gears 182 and 184 for rotation therewith. Auxiliary countershaft gears 182 are constantly meshed with range/output gear 86 which is rotationally fixed to mainshaft 128 while auxiliary section countershaft gears 84 are constantly meshed with output gear 188.

A 2-position synchronized jaw clutch assembly 192, which is axially positioned by means of shift fork 194 and the range section shifting actuator assembly 196, is provided for clutching either gear 188 to output shaft 190 for low range operation or gear 186 to output shaft 190 for direct or high range operation of the compound transmission 110. The shift "repeat H" type pattern for compound range type transmission 110 is schematically illustrated in **FIGURE 2B**.

Although the range type auxiliary section 114 is illustrated as a two-speed section utilizing spur or helical type gearing, it is understood that the present invention is also applicable to range type transmissions utilizing combined splitter/range type auxiliary sections, having three or more selectable range ratios and/or utilizing planetary type gearing. Also, as indicated above, any one or more of clutches 160, 162 or 164 may be of the synchronized jaw clutch type and transmission sections 112 and/or 114 may be of the single countershaft type. Selection of low or high range operation of the transmission 110 is by means of an operator actuated switch or button 198 which was usually located at the shift lever 172.

Transmission 110 is provided with a rotational speed sensor 100 for sensing the rotational speed of output shaft 90 and for providing an output signal 100A

indicative thereof. As is well known, the rotational speed of output shaft 190 is indicative of the ground speed of the vehicle in which transmission 110 is installed.

It is known to arrange a range-change automatic inhibiting control device in a manual range-changing arrangement to inhibit range downshifts above a predetermined vehicle speed. Manual range shifting is typically by a pneumatic or electrical switch on a shift lever knob used for shifting the main transmission section within the ranges. As applied to the present invention, the reference speeds at which selection of the 1/5 and 2/6 rails is prohibited will vary with engaged range section ratio. For example, in the transmission of **FIGURES 2-2B**, the reference value in low range may be 17 KPH (11 MPH) and 61 KPH (38 MPH) in high range.

Accordingly, it may be seen that a new and improved control system for automatically controlling the downshifting of an otherwise manually shifted transmission or transmission section has been provided.

### Claims

1. A downshift control for a manually shifted vehicular transmission having a first (first/second) manually selectable forward ratio and a second (fifth/sixth) manually selectable forward ratio, said first ratio intended for lower vehicle ground speed operation than said second ratio and having a predetermined maximum vehicle ground speed at which downshift engagement thereof is allowed, said control including means (100) to sense current vehicular ground speed, and said transmission including a shift mechanism manually movable in a selection direction (Y-Y) to a first position for selection of engaging and disengaging said first ratio, and to second position, distinct from said first position, for selection of engaging and disengaging said second ratio, said shift mechanism manually movable in an engagement/disengagement direction (X-X), distinct from said selection direction, to cause engagement and disengagement of a selected ratio, said control characterized by:  
 said control effective to automatically, mechanically block (216) manual movement to said first position in said selection direction if said current vehicular ground speed exceeds said predetermined maximum vehicular ground speed.
2. The control of claim 1 wherein said shift mechanism includes a shaft (200), said shaft being axially moveable along its axis as said mechanism is moved in the selection direction thereof.
3. The control of claim 1 wherein said shift mechanism includes a shaft (300), said shaft being rotatable about its axis as said mechanism is moved in the selection direction thereof.
4. The control of claims 1 or 2 wherein said shaft (200) is rotatable about said axis as said mechanism is moved in the engagement/disengagement direction thereof.
5. The control of claims 1 or 3 wherein said shaft (300) is movable axially along said axis as said mechanism is moved in the engagement/disengagement direction thereof.
6. The control of any of claims 1-5 wherein said transmission comprises the main transmission section (112) of a range-type compound transmission including a multiple ratio range section (114) connected in series with said main transmission section, said predetermined maximum vehicle ground speed having a value variable with engaged range section ratio.
7. The control of claim 1 wherein said means (216) to automatically, mechanically block includes a plunger assembly having a first position wherein said plunger is relatively retracted and a second position wherein said plunger is relatively extended, said plunger in the first position thereof, allowing said mechanism to move freely between the first and second positions thereof in said selection direction, and in the second position thereof interfering with said mechanism moving from said second to said first position in said selection direction.
8. A downshift control for a manually shifted vehicular transmission according to any one or more of claims 1-7 and having a third (fifth/sixth) manually selectable ratio, said third ratio intended for higher vehicle ground speed operation than said first or second ratios, said transmission including a shift mechanism having a shaft manually movable in a selection direction (Y-Y) to any one of first second or third distinct positions for selection of engaging and disengaging said first second and third ratios, said second position located between said first and third positions in said selection directions, said control further characterized by:  
 control means for sensing a value (OS) indicative of current vehicle ground speed and for comparing said value indicative of current vehicle ground speed to a first reference value (REF<sub>1</sub>) corresponding to said first predetermined maximum vehicle ground speed and to a second reference value (REF<sub>2</sub>) corresponding to said second predetermined maximum vehicle ground speed,  
 mechanical blocking means (216) responsive to control signals from said control means having (i) a non-blocking position (216A) when said value indicative of ground speed is less than

said first reference value ( $OS < REF_1 < REF_2$ ) wherein said shaft is not blocked from movement between said first, second and third positions thereof in the selection direction; (ii) an intermediate blocking position (216B) for blocking movement of said shaft to said first position in said selection direction, but allowing movement of said shaft to said second position in said selection direction, if said value indicative of vehicle ground speed is greater than said first reference value but less than said second reference value ( $REF_2 > OS > REF_1$ ); and (iii) a fully blocking position (216C) for blocking movement of said shaft, both to said first and said second positions thereof, in said selection direction if said value indicative of vehicle ground speed is greater than said second reference value ( $OS > REF_2 > REF_1$ ).

9. The downshift control of claim 8 wherein said mechanical blocking means is biased to the non-blocking position thereof. 20
10. The downshift control of claims 8 or 9 wherein said shaft (200) is axially movable along its axis in the selection direction. 25
11. The control according to any of claims 8, 9 or 10 wherein said shaft (300) is rotatable about said axis as said mechanism is moved in the engagement/disengagement direction thereof. 30
12. The control of claim 8 wherein said shaft defines a first shoulder (210) and a second shoulder (212), said first shoulder further radially displaced from the axis of said shaft than said second shoulder, and said mechanical blocking mechanism includes a blocking plunger extending substantially radially inwardly toward the axis of said shaft, said non-blocking position comprising a retracted position of said plunger wherein said plunger is not engageable with said first or second shoulders, said intermediate blocking position comprising a partially extended position of said plunger wherein said first shoulder, but not said second shoulder, is engageable by said plunger and said fully blocking position comprising full extension of said plunger wherein said second shoulder is engageable by said plunger. 35 40 45

#### Patentansprüche

1. Zurückschaltsteuerung für ein manuell geschaltetes Fahrzeuggetriebe mit einem ersten (erster/zweiter) manuell auswählbaren Vorwärtsgang und einem zweiten (fünfter/sechster) manuell auswählbaren Vorwärtsgang, wobei der erste Gang zum Betrieb des Fahrzeuges mit einer niedrigeren Ge- 55

schwindigkeit vorgesehen ist als der zweite Gang, und mit einer vorbestimmten maximalen Fahrzeuggeschwindigkeit, bei der das Zurückschalten desselben gestattet ist, wobei die Steuerung Mittel (100) aufweist, um die Fahrzeuggeschwindigkeit zu erfassen, und wobei das Getriebe einen Schaltmechanismus enthält, der manuell in einer ausgewählten Richtung (Y-Y) in eine erste Position zur Auswahl des Ein- und Ausrückens der ersten Gangstufe und in eine zweite Position bewegbar ist, die von der ersten Position verschieden ist, um das Ein- und Ausrücken der zweiten Gangstufe auszuwählen, wobei der Schaltmechanismus manuell in einer Einrück/Ausrückrichtung (X-X) bewegbar ist, die von der Auswahlrichtung verschieden ist, um das Ein- und Ausrücken der ausgewählten Gangstufe zu veranlassen, wobei die Steuerung dadurch gekennzeichnet ist:

daß die Steuerung das automatische mechanische Sperren (216) der manuellen Bewegung in die erste Position der Auswahlrichtung sperrt, wenn die aktuelle Fahrzeuggeschwindigkeit eine vorbestimmte maximale Fahrzeuggeschwindigkeit übersteigt.

2. Steuerung nach Anspruch 1, bei der der Schaltmechanismus eine Welle (200) aufweist, wobei die Welle axial entlang ihrer Achse bewegbar ist, wenn der Mechanismus in seiner Auswahlrichtung bewegt wird.
3. Steuerung nach Anspruch 1, bei der der Schaltmechanismus eine Welle (300) aufweist, wobei die Welle um ihre Achse drehbar ist, wenn der Mechanismus in seiner Auswahlrichtung bewegt wird.
4. Steuerung nach Anspruch 1 oder 2, bei der die Welle (200) um die Achse drehbar ist, wenn der Mechanismus in seiner Einrück/Ausrückrichtung bewegt wird.
5. Steuerung nach Anspruch 1 oder 3, bei der die Welle (300) axial entlang der Achse bewegbar ist, wenn der Mechanismus in seiner Einrück/Ausrückrichtung bewegt wird.
6. Steuerung nach einem der Ansprüche 1 bis 5, bei der das Getriebe die Hauptgetriebegruppe (112) eines Verbundgetriebes vom Rangtyp mit einer vielläufigen Rangegruppe (114) enthält, die mit der Hauptgetriebegruppe hintereinander angeordnet ist, wobei die vorbestimmte maximale Fahrzeuggeschwindigkeit einen Wert hat, der mit der eingerückten Rangegruppengangstufe veränderlich ist.
7. Steuerung nach Anspruch 1, bei der das Mittel (216) zum automatischen mechanischen Verriegeln eine Stoßelanordnung enthält, die eine erste

Position aufweist, in der der Stößel relativ zurückgezogen ist, und die eine zweite Position aufweist, in der der Stößel vergleichsweise vorgeschoben ist, wobei der Stößel in seiner ersten Position die freie Bewegung des Mechanismus zwischen seiner ersten und seiner zweiten Position in der Auswahlrichtung gestattet und in seiner zweiten Position den sich aus der zweiten in die erste Position in der Auswahlrichtung bewegendenden Mechanismus blockiert.

8. Zurückschaltsteuerung für ein manuell geschaltetes Fahrzeuggetriebe nach einem der Ansprüche 1 bis 7 und mit einem dritten (fünfter/sechster), manuell auswählbaren Gang, wobei der dritte Gang für höhere Fahrzeuggeschwindigkeiten als der erste oder zweite Gang vorgesehen ist, wobei das Getriebe einen Schaltmechanismus mit einer Welle aufweist, die manuell in einer Auswahlrichtung (Y-Y) in die erste, zweite oder dritte gesonderte Position zur Auswahl des Ein- und Ausrückens des ersten, zweiten und dritten Ganges manuell bewegbar ist, wobei die zweite Position in der Auswahlrichtung zwischen der ersten und der dritten Position angeordnet ist, wobei die Steuerung außerdem gekennzeichnet ist durch:

Steuermittel zum Erfassen eines Wertes (OS), der für die aktuelle Fahrzeuggeschwindigkeit kennzeichnend ist, und zum Vergleichen dieses die Fahrzeuggeschwindigkeit kennzeichnenden Wertes mit einem ersten Referenzwert ( $REF_1$ ), der einer ersten vorbestimmten maximalen Fahrzeuggeschwindigkeit entspricht, und mit einem zweiten Referenzwert ( $REF_2$ ), der der zweiten vorbestimmten maximalen Fahrzeuggeschwindigkeit entspricht,

mechanische Sperrmittel (216), die auf Steuerungssignale des Steuermittels reagieren und die (i) eine entspernte Position (216A) haben, wenn der die Fahrzeuggeschwindigkeit kennzeichnende Wert geringer ist als der erste Referenzwert ( $OS < REF_1 < REF_2$ ), wobei die Welle nicht gegen die Bewegung zwischen ihrer ersten, zweiten und ihrer dritten Position in Auswahlrichtung gesperrt ist; (ii) eine Zwischensperrposition (216B) zum Sperren der Bewegung der Welle in Ausfallrichtung in die erste Position haben, wobei jedoch die Bewegung der Welle in Auswahlrichtung in die zweite Position freigegeben ist, wenn der die Fahrzeuggeschwindigkeit kennzeichnende Wert größer als der erste Referenzwert, jedoch kleiner als der zweite Referenzwert ( $REF_2 > OS > REF_1$ ) ist; und die (iii) eine voll gesperrte Position (216C) zum Blockieren der Bewegung der Welle in der Auswahlrichtung sowohl in ihre erste als auch in ihre

zweite Position haben, wenn der die Fahrzeuggeschwindigkeit kennzeichnende Wert größer ist als der zweite Referenzwert ( $OS > REF_2 > REF_1$ ).

9. Zurückschaltsteuerung nach Anspruch 8, bei der das mechanische Sperrmittel auf seine nichtgesperrte Position hin vorgespannt ist.
10. Zurückschaltsteuerung nach den Ansprüchen 8 oder 9, bei der die Welle (200) entlang ihrer Achse in der Auswahlrichtung axial bewegbar ist.
11. Steuerung nach einem der Ansprüche 8, 9 oder 10, bei der die Welle (300) um die Achse drehbar ist, wenn der Mechanismus in seiner Einrück/Ausrückrichtung bewegt wird.
12. Steuerung nach Anspruch 8, bei der die Welle eine erste Schulter (210) und eine zweite Schulter (212) definiert, wobei die erste Schulter von der Achse der Welle radial weiter entfernt ist als die zweite Schulter und bei der der mechanische Sperrmechanismus einen Sperrstößel enthält, der sich im wesentlichen radial nach innen auf die Achse der Welle zu erstreckt, wobei die entspernte Position eine zurückgezogene Position des Stößels ist, in der der Stößel mit der ersten oder der zweiten Schulter nicht in Eingriff bringbar ist, die Zwischensperrposition eine teilweise vorgeschobene Position des Stößels ist, in der die erste Schulter, jedoch nicht die zweite Schulter, mit dem Stößel in Eingriff bringbar ist, und wobei die vollgesperrte Position beinhaltet, daß der Stößel voll ausgefahren ist, so daß die zweite Schulter mit dem Stößel in Eingriff bringbar ist.

## Revendications

1. Commande de rétrogradation de vitesse pour une transmission de véhicule à changement de vitesse manuel comportant un premier rapport de marche avant (première/seconde vitesse) pouvant être sélectionné manuellement et un second rapport de marche avant (cinquième/sixième vitesse) pouvant être sélectionné manuellement, ledit premier rapport étant prévu pour un fonctionnement avec une vitesse au sol du véhicule plus faible que dans ledit second rapport, et avec une vitesse au sol maximale prédéterminée du véhicule, pour laquelle l'engagement d'un rapport inférieur est autorisé, ladite commande comprenant des moyens (100) pour détecter la vitesse au sol actuelle du véhicule, et ladite transmission comprenant un mécanisme de changement de vitesse déplaçable manuellement dans une direction de sélection (Y-Y) vers une première position pour la sélection de l'engagement et du dé-



- gagement dudit premier rapport, et vers une seconde position, distincte de ladite première position, pour la sélection de l'engagement et du déengagement dudit second rapport, ledit mécanisme de changement de vitesse étant déplaçable manuellement dans une direction d'engagement/de déengagement (X-X), distincte de ladite direction de sélection, pour provoquer l'engagement et le déengagement d'un rapport sélectionné, ladite commande étant caractérisée en ce que:
- ladite commande réagit de manière à empêcher mécaniquement de façon automatique (216) un déplacement manuel vers ladite première position dans ladite direction de sélection si ladite vitesse au sol actuelle du véhicule dépasse ladite vitesse au sol maximale prédéterminée du véhicule.
2. Commande selon la revendication 1, dans laquelle ledit mécanisme de changement de vitesse comprend un arbre (200), ledit arbre étant déplaçable axialement le long de son axe, lorsque ledit mécanisme est déplacé dans sa direction de sélection.
  3. Commande selon la revendication 1, dans laquelle ledit mécanisme comprend un arbre (300), ledit arbre pouvant tourner autour de son axe lorsque ledit mécanisme est déplacé dans sa direction de sélection.
  4. Commande selon la revendication 1 ou 2, dans laquelle ledit arbre (200) peut tourner autour dudit axe lorsque ledit mécanisme est déplacé dans sa direction d'enclenchement / de désenclenchement.
  5. Commande selon la revendication 1 ou 3, dans laquelle ledit arbre (300) est déplaçable axialement le long dudit axe lorsque ledit mécanisme est amené dans sa direction d'enclenchement / de désenclenchement.
  6. Commande selon l'une quelconque des revendications 1-5, dans laquelle ladite transmission comprend la section principale (112) d'une transmission compound du type à groupe-relais comprenant une section de groupe-relais (114) à rapports multiples raccordée en série avec ladite section principale de la transmission, ladite vitesse au sol maximale prédéterminée du véhicule possédant une valeur variable avec le rapport engagé de la section de groupe-relais.
  7. Commande selon la revendication 1, dans laquelle lesdits moyens (216) pour réaliser le blocage mécanique automatique incluent un ensemble à piston, possédant une première position dans laquelle ledit piston est rétracté de façon relative, et une seconde position dans laquelle ledit piston est déployé de façon relative, ledit piston dans sa première

position permettant audit mécanisme de se déplacer librement entre ses première et seconde positions dans ladite direction de sélection, et interférant, dans sa seconde position, avec ledit mécanisme se déplaçant depuis ladite seconde position vers ladite première position dans ladite direction de sélection.

8. Commande de rétrogradation de vitesse pour une transmission de véhicule à changement de vitesse manuel selon l'une quelconque ou plusieurs des revendications 1-7 et possédant un troisième rapport (cinquième/sixième vitesse) pouvant être sélectionné manuellement, ledit troisième rapport étant destiné pour une vitesse au sol du véhicule plus élevée que pour lesdits premier ou second rapports, ladite transmission comprenant un mécanisme de changement de vitesse possédant un arbre déplaçable manuellement dans une direction de sélection (Y-Y) vers l'une ou l'autre des première, seconde et troisième positions distinctes pour la sélection de l'engagement et du déengagement desdits premier, second et troisième rapports, ladite seconde position étant située entre lesdites première et troisième positions dans lesdites directions de sélection, ladite commande étant caractérisée en outre par :

des moyens de commande pour détecter une valeur (OS) indicative d'une vitesse au sol actuelle du véhicule et pour comparer ladite valeur indicative de vitesse au sol actuelle du véhicule à une première valeur de référence ( $REF_1$ ) correspondant à ladite première vitesse au sol maximale prédéterminée du véhicule et à une seconde valeur de référence ( $REF_2$ ) correspondant à ladite seconde vitesse au sol maximale prédéterminée du véhicule, des moyens mécaniques de blocage (216) aptes à répondre à des signaux de commande délivrés par lesdits moyens de commande possédant (i) une position de non blocage (216A) lorsque ladite valeur indicative de la vitesse au sol est inférieure à ladite première valeur de référence ( $OS < REF_1 < REF_2$ ), ledit arbre n'étant pas bloqué contre un déplacement entre lesdites première, seconde, et troisième positions dans la direction de sélection; (ii) une position intermédiaire de blocage (216B) pour empêcher un déplacement dudit arbre vers ladite première position dans ladite direction de sélection, mais permettant un déplacement dudit arbre vers ladite seconde position dans la direction de sélection, si ladite valeur indicative de la vitesse au sol du véhicule est supérieure à ladite première valeur de référence, et inférieure à ladite seconde valeur de référence ( $REF_2 > OS > REF_1$ ); et (iii) une position de blocage complet (216C) pour empêcher un dépla-

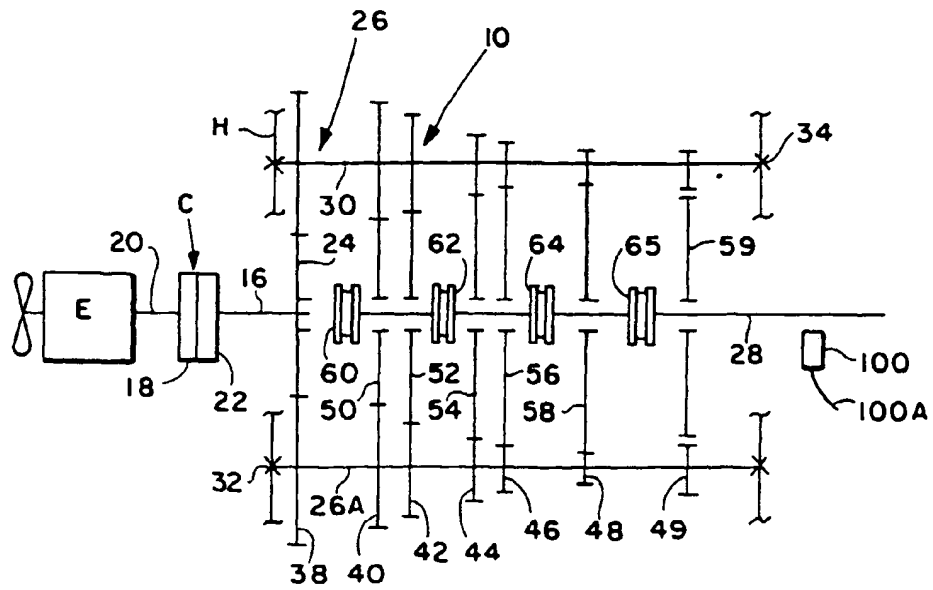
cement dudit arbre à la fois en direction desdites première et seconde positions de ce dernier, dans ladite direction de sélection si la valeur indicative de la vitesse au sol du véhicule est supérieure à ladite seconde valeur de référence ( $OS > REF_2 > REF_1$ ). 5

9. Commande de rétrogradation de vitesse selon la revendication 8, dans laquelle lesdits moyens de blocage mécanique sont sollicités dans leur position de non blocage. 10
10. Commande de rétrogradation selon les revendications 8 ou 9, dans laquelle ledit arbre (200) est déplaçable axialement le long de son axe dans la direction de sélection. 15
11. Commande selon l'une quelconque des revendications 8, 9 ou 10, dans laquelle ledit arbre (300) peut tourner autour dudit axe lorsque ledit mécanisme est déplacé dans sa direction d'engagement / de déengagement. 20
12. Commande selon la revendication 8, dans laquelle ledit arbre définit un premier épaulement (210) et un second épaulement (212), ledit premier épaulement étant davantage décalé radialement par rapport à l'axe dudit arbre que ledit second épaulement, et ledit mécanisme de blocage mécanique comprend un piston de blocage qui s'étend essentiellement radialement vers l'intérieur en direction de l'axe dudit arbre, ladite position de non blocage comprenant une position rétractée dudit piston, dans laquelle ledit piston ne peut pas venir en contact avec ledit premier ou second épaulement, ladite position de blocage intermédiaire comprenant une position partiellement déployée dudit piston, dans laquelle ledit piston peut s'appliquer contre ledit premier épaulement, mais pas contre ledit second épaulement, et ladite position de blocage complet comprenant une extension complète dudit piston dans laquelle ledit piston peut venir s'appliquer contre ledit second épaulement. 25  
30  
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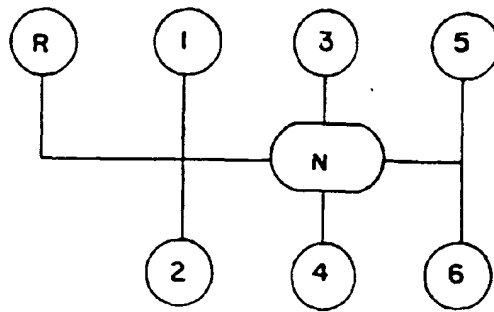
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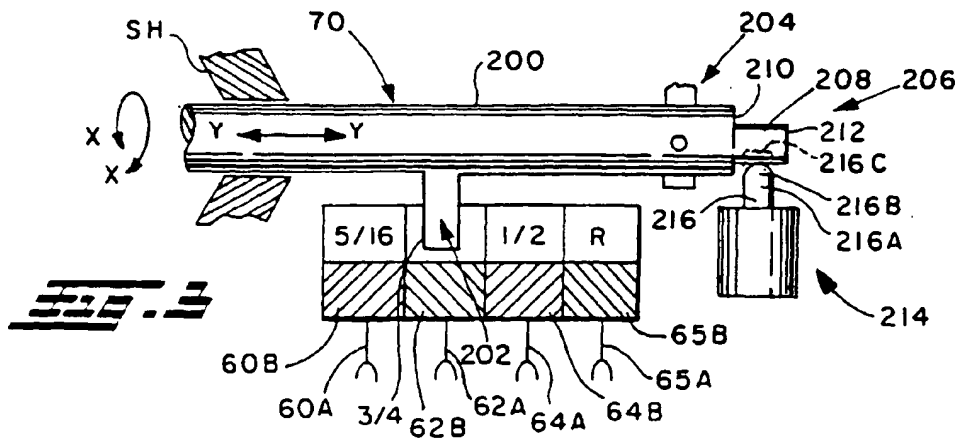
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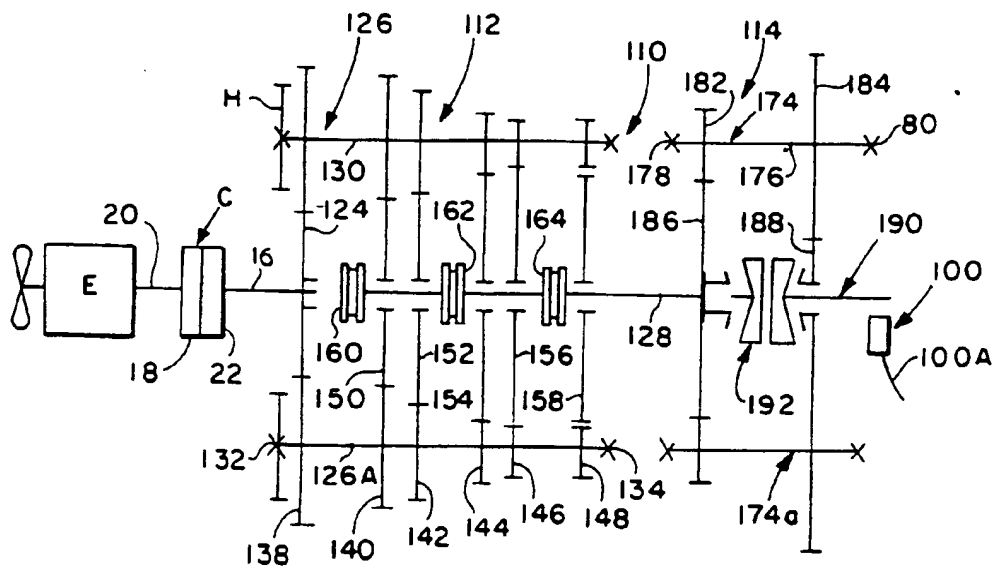
**Fig. 1**



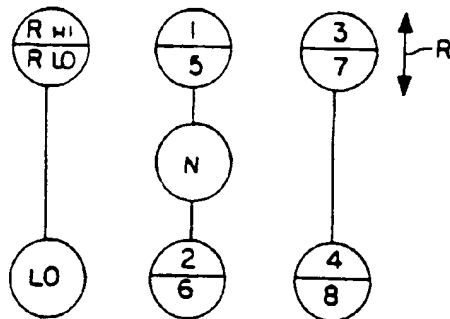
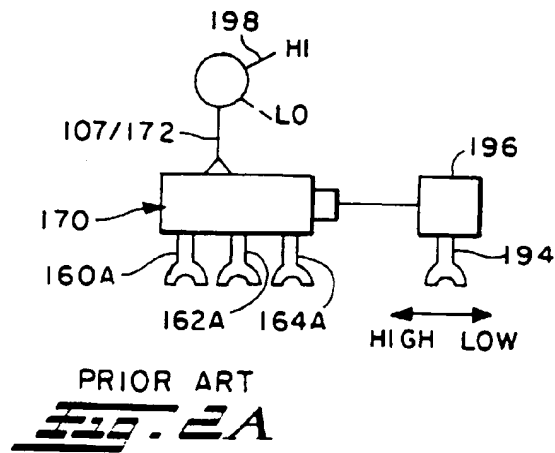
**Fig. 1A**



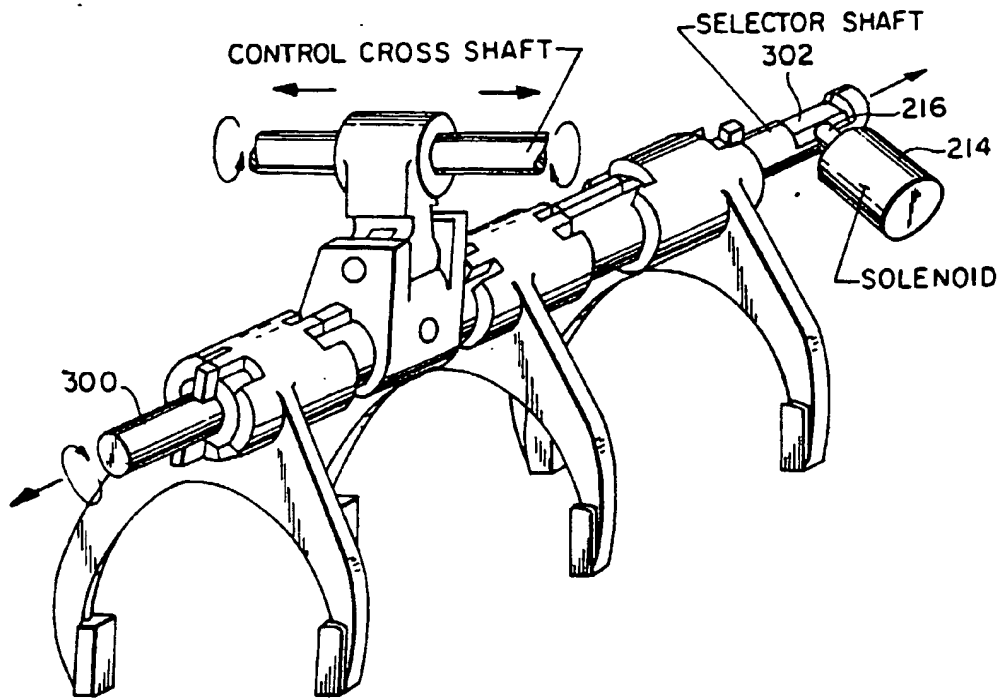
**Fig. 2**



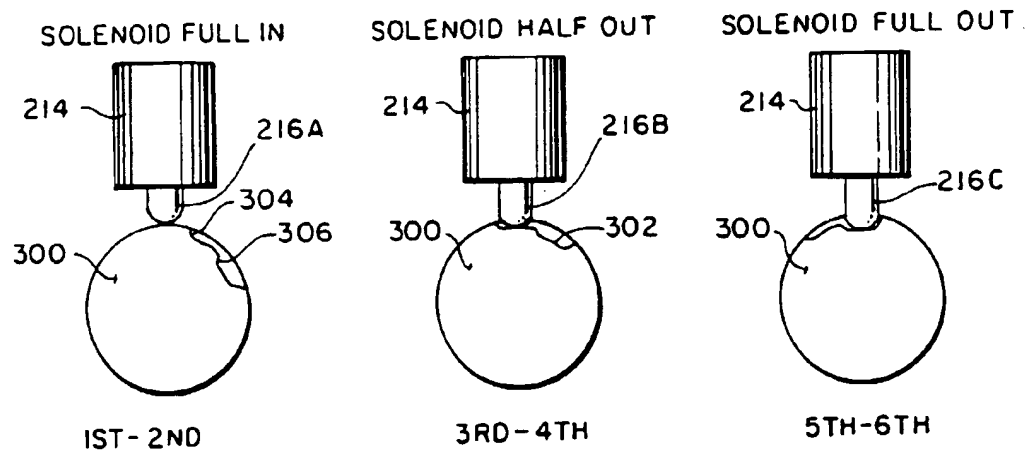
**50.2**



**59.2B**



**Fig. 4**



**Fig. 4A**

**Fig. 4B**

**Fig. 4C**

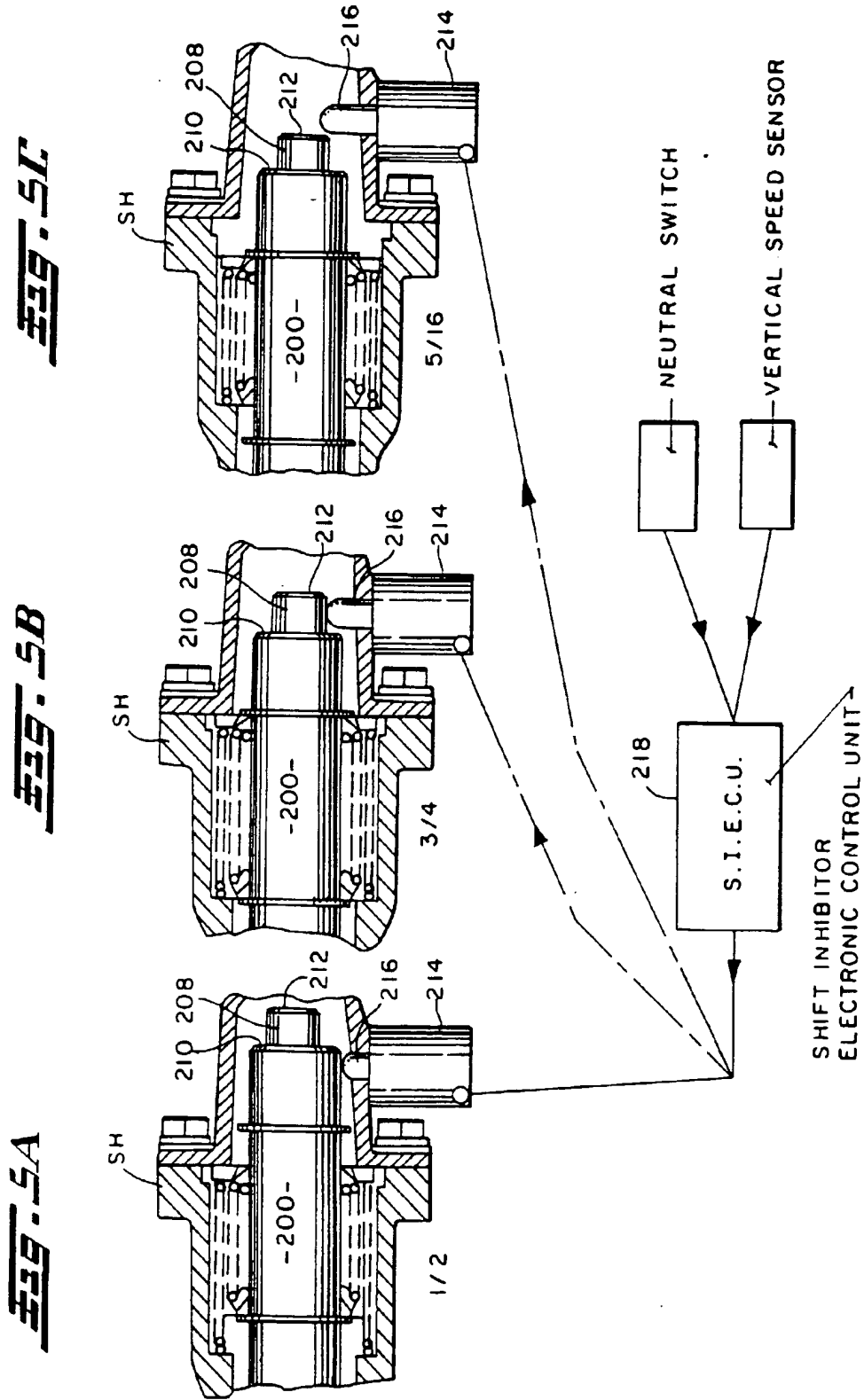


Fig. 6B

Fig. 6A

